CLAIMS

What is claimed is:

1. A rectilinear ion trap mass analyzer comprising:

spaced x and y pairs of flat RF electrodes disposed in the zx and zy plane to define a trapping volume;

an RF voltage source for applying RF voltages between the x and y pairs of electrodes to generate RF trapping fields in the xy plane;

end electrodes at the ends of trapping volume defined by said pairs of x and y electrodes;

a DC voltage source for applying DC voltages to said at least end electrodes to provide DC trapping fields along the z axis whereby ions are trapped in the trapping volume; and

an AC voltage source for applying AC voltages to at least one pair of said spaced x or y electrodes to excite ions in the corresponding zx or zy plane.

2. A rectilinear ion trap, as in claim 1 in which the end electrodes comprise plates disposed in the xy plane.

3. A rectilinear ion trap, as in claim 1 in which the end electrodes comprise spaced pairs of flat end RF electrodes disposed in the zx and zy plane.

4. A rectilinear ion trap, as in claim 3 including end plates disposed in the xy plane at the ends of said spaced pairs of flat end RF electrodes.

5. A rectilinear ion trap, as in claims 2 or 4 in which at least one of said end plates includes a slit oriented in the same direction as the applied AC voltage whereby to enhance ion ejection in the z direction.

6. A rectilinear ion trap, as in claims 2 or 4 in which at least one of said end plates includes slits oriented in the x and y directions.

7. A rectilinear ion trap, as in claim 1 in which at least one of the x or y pairs of plates to which the AC voltage is applied includes a slit or elongated aperture oriented in the z direction.

8. A rectilinear ion trap, as in claim 5 in which at least one plate of the x and y electrodes includes a slit or elongated aperture.

9. A rectilinear ion trap, as in claim 2 in which the x and y electrodes and the end electrode define a cubic trapping volume and all of the plates include crossed slits or elongated apertures.

10. A multistage ion processing system including:

a plurality of rectilinear ion traps each comprising:

spaced x and y pairs of flat electrodes disposed in the zx and zy plane to define a trapping volume;

an RF voltage source for applying RF voltages between the x and y pairs of electrodes to generate RF trapping fields in the xy plane;

end electrodes at the ends of the trapping volume defined by said pairs of x and y electrodes;

a DC voltage source for applying DC voltages to said at least end electrodes to provide DC trapping fields along the z axis whereby ions are trapped in the trapping volume; and

an AC voltage source for applying AC voltages to at least one pair of said spaced x or y electrodes to excite ions in the corresponding zx or zy plane said rectilinear ion traps coupled to one another whereby ion can be transferred between ion traps.

11. A multistage ion processing system as in claim 10 which comprises at least three rectilinear ion traps.

12. A multistage ion processing system as in claim 11 in which the end electrodes comprise end plates with at least one slit and the rectilinear ion traps are arranged in series whereby ions are transferred between ion traps in the z direction.

13. A multistage ion processing system as in claim 11 in which at least one of the flat electrodes disposed in the zx and zy direction includes a slit oriented in the z direction and the rectilinear ion traps are arranged in parallel whereby ions are transferred between ion traps in the x or y direction.

14. A multistage ion processing system as in claim 11 in which said plurality of rectilinear ion traps are combined in a serial and a parallel array.

15. A multistage ion processing system as in claim 11 in which said rectilinear ion traps are arranged with their axis orthogonally arranged and the traps are coupled to one another by a rectilinear ion trap whereby ions can be transferred in the x, y and z direction.

16. A multistage ion processing system as in claim 15 in which the coupling rectilinear ion trap is a cubic ion trap.

17. A multistage ion processing system as in claim 12 in which the RF electrodes of the traps have different spacing.

18. A multistage ion processing system as in claim 13 in which the RF electrodes of the traps have a different spacing.

19. The method of operating the ion trap of claim 1 to isolate ions of interest which comprises applying RF/DC isolation voltages to the RF electrodes to trap the ions of interest.

20. The method of claim 19 including applying an AC voltage to a pair of the RF electrodes after isolation of ions to fragment the ions.

21. The method of operating the ion trap of claim 1 to isolate ions of interest comprising applying a broadband AC voltage to a pair of the RF electrodes which has gaps in the frequency spectrum whereby ions are resonated out of the trap except for ions having an excitation frequency at the gap frequency.

22. The method of operating the ion trap of claim 5 which comprises applying an AC voltage to the RF pair of electrodes in the direction of the slit.

23. The method of operating the ion trap of claim 7 which includes applying RF trapping voltages to the RF electrodes and an AC voltage across the set of RF electrodes including the slit.

24. The method of operating the ion trap of claim 7 which includes applying an RF voltages, one set of RF electrodes and AC voltages of different frequency to the other sets of RF electrodes to eject ions of different masses in the x and y directions.

25. The method of operating an ion trap of claim 9 which comprises selecting the direction of motion of trapped ions by changing the combination of RF, AC and DC waveforms applied to the pairs of electrodes.